HD XRF Analyzer

for Screening & Quantification of Pb in Toys

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Company Highlights

Founded: 1990

Location: East Greenbush, NY

Products:

- Application specific X-Ray Analyzers

- X-Ray Optics & Beam Systems

Demonstration

- **Test #1: Quantification: 45 ppm Pb in 30 μm paint on ABS plastic**

- Test #2: Screening: 80 ppm Pb in 30 μm paint on ABS plastic

- Test #3: Quantification: 80 ppm Pb in 30 μm paint on ABS plastic

- Test #4: Quantification: 80 ppm Pb in 15 μm paint on ABS plastic – 2 mm spot

- Test #5: Quantification: SRM 8115A 94 ppm in homogenous sample- 20s measurement

- Test #6: Screening: 160 ppm in 30 μm paint on irregularly shaped wooden toy

Pb levels in the paint layers are correlated to ICP/OES and AA by outside test labs
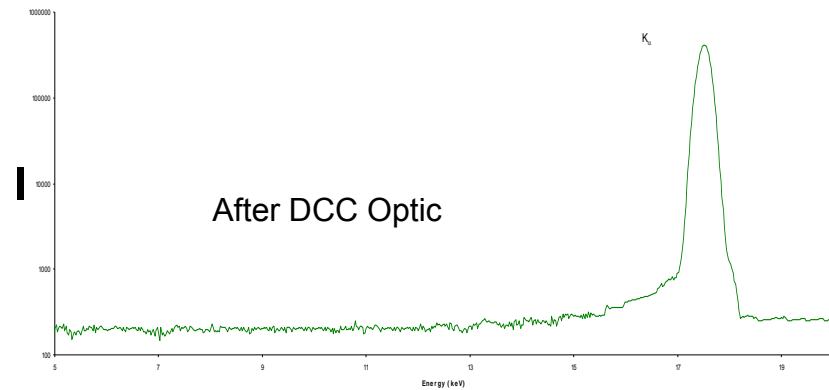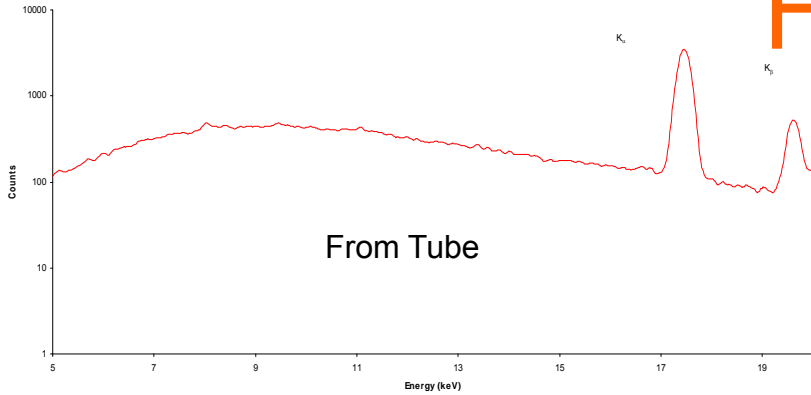
HD**XRF**

Conventional XRF

From Tube

From Sample

Sample
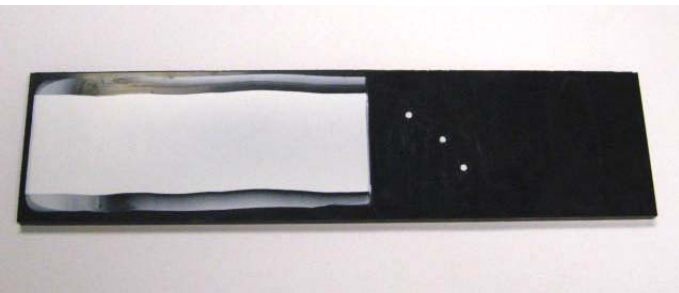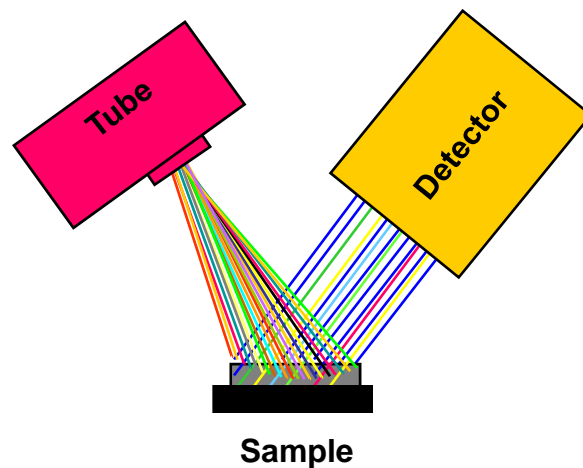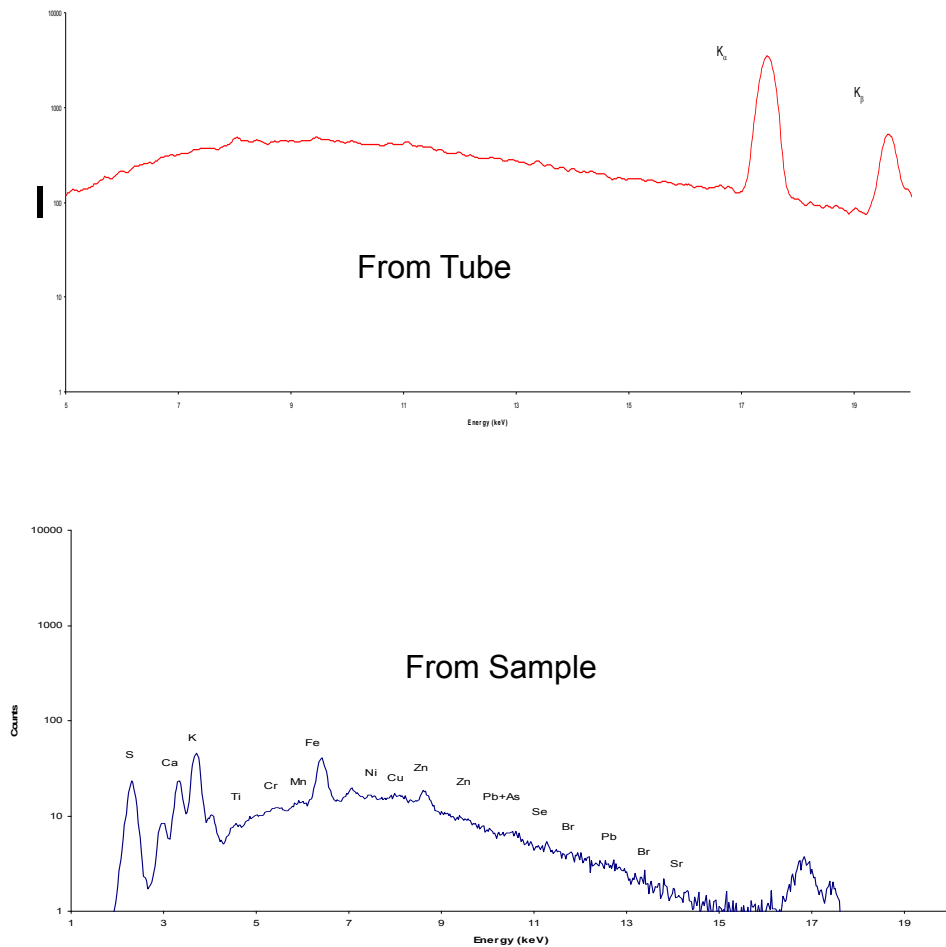
- Unable to quantify or even detect low concentrations (poor signal-to-noise ratio)

- Average across multiple features and materials (large area illuminated)

- Average of the paint and the substrate

HD XRF

From Tube

After DCC Optic

From Sample

Tube Source

DCC Optic

Detector

Sample
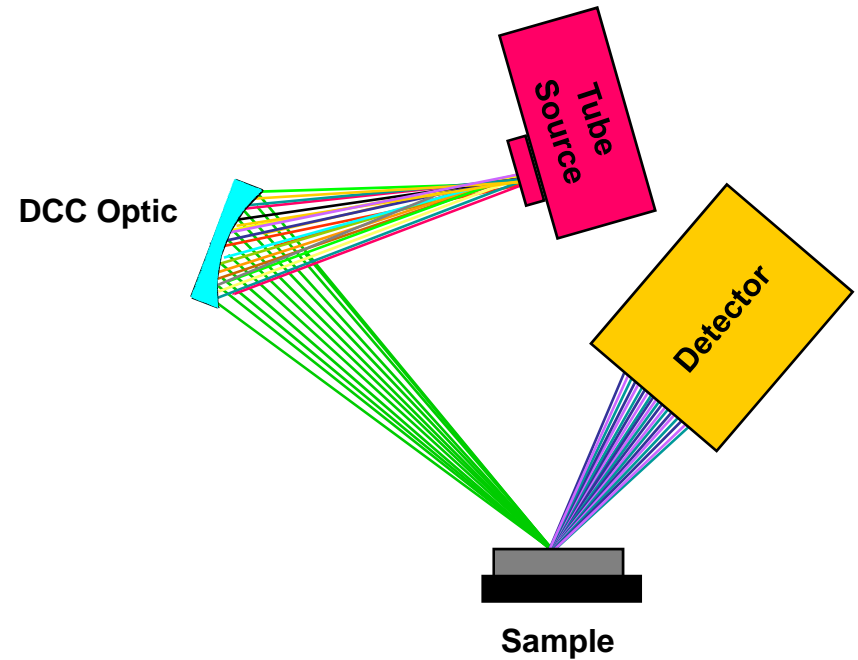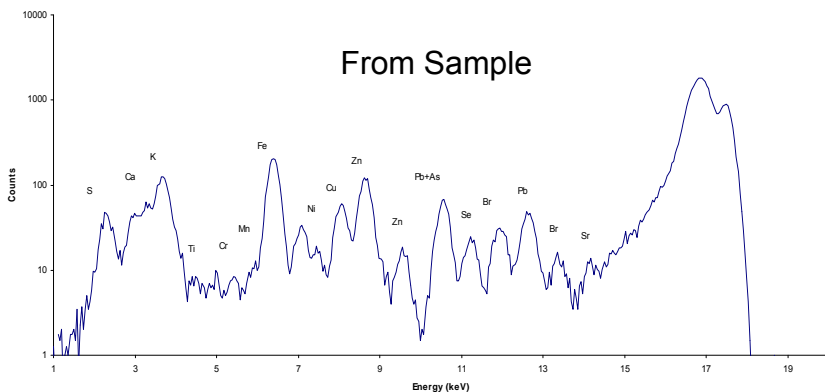
- Detect and quantify trace concentrations (excellent signal-to-noise) in:
  - paint
  - substrate

- Results for small features

Screening Mode

- Typical: 1 min. screening – user selectable

- 90 ppm level in 20um paint layer

- For thinner layers – extend screening time

- Low background enables fast screening for low concentrations of Pb in both paint and substrate

- Measurement averages results from substrate and paint layer

- Any Pb concentration > detection limit is reported as
  Pb DETECTED

Low Noise → Increased Sensitivity

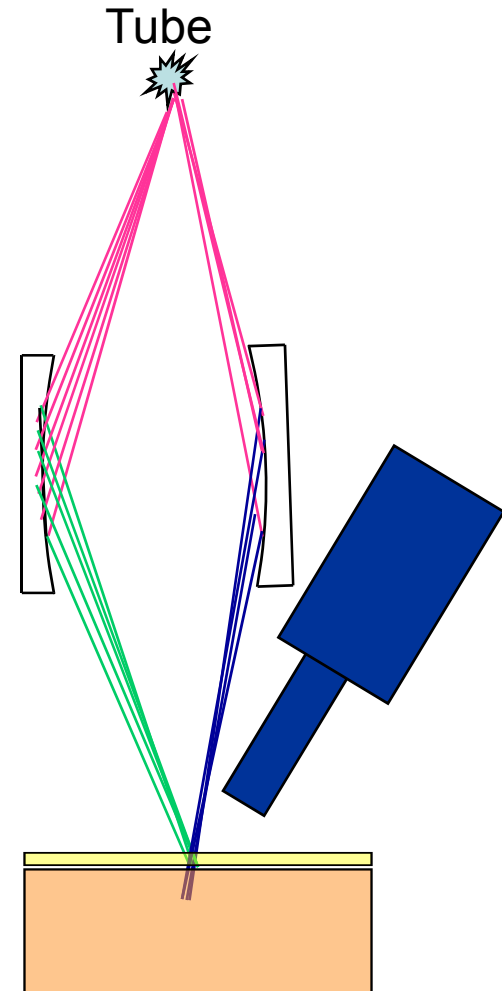**Conventional XRF**   **HD XRF**
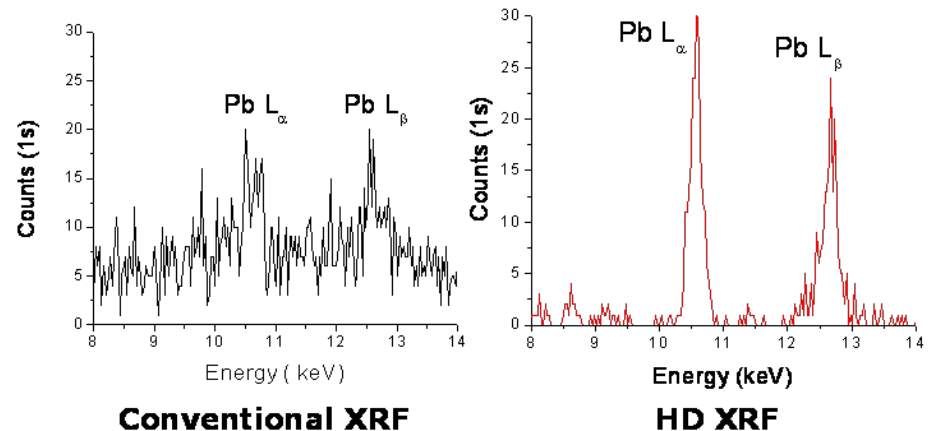
Example: Only 1 second of data collection

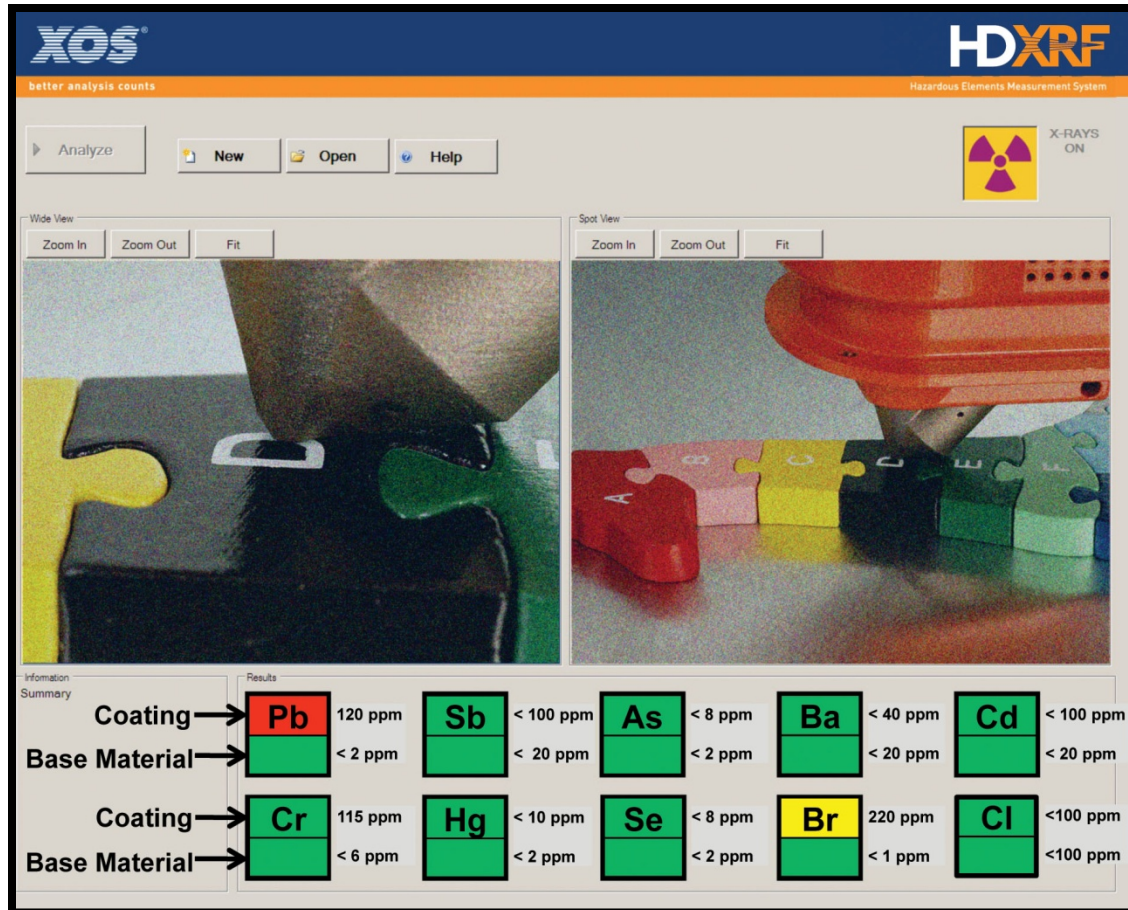Test # 2: Screening: 80 ppm Pb in 30 um paint on ABS

Quantification Mode

- Quantifies and reports Pb concentration in:
  - the substrate
  - paint layers

- HD XRF: Multiple optic channels enable selective use of monochromatic excitation beams at selected energy levels

- Measurement time ~ 4 min.

- Low background ensures low detection limit for Pb in paint and substrate

Tube

Test #3: Quantification: 80 ppm Pb in 30 um paint on ABS

HD XRF

User Interface – Quantification Mode

- Multi-element capacity
- User selects limits
- Encrypted secure data for recordkeeping and verification.
- Two images
  - Whole toy
  - Measurement spot

All images date & time stamped
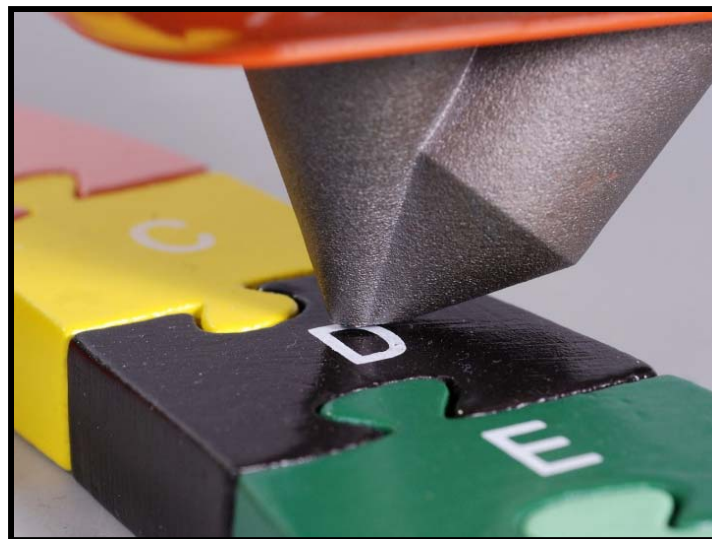
Measuring Fine Details

HDX 1000
Analysis Area

Test #4: Quantification: 80 ppm Pb in 15 um paint on ABS – 2 mm spot

Small Spot Capability

- Small measurement area capability eliminates pass/fail ambiguity.

- µg/cm^2 vs. ppm (wt)

- Enables accurate and repeatable results of curved and irregular shaped surfaces.

Paint Layer Thickness Limitation

- ## Screening Mode:
  - In 1 min detect presence of Pb
  - Ensures concentration in the paint does not exceed 90 ppm in 20 um paint layer

- ## Quantification Mode:
  - Quantify Pb at 80 ppm in 5 um paint layer.

- ## Porous substrates:
  - substrate / paint layer interface not defined.

HDXRF
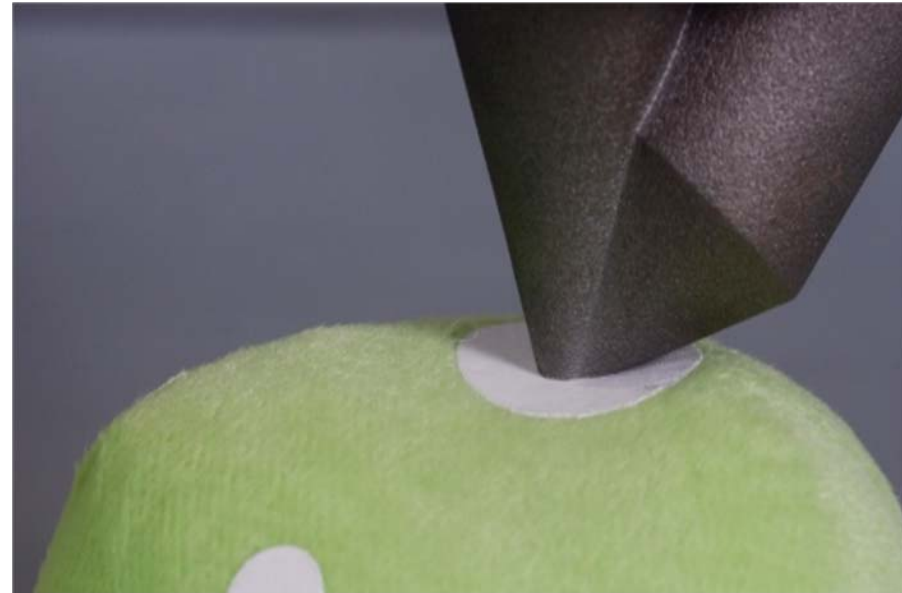
Precision and Accuracy

Limits of Detection

HD**XRF**	Pb	Cd	Cr	As	Br	Sb	Se	Hg	Ba	Cl
Uniform PE	1	5*	3	0.8	0.6	2	0.8	1	3	50
Paint/Layers	8	40*	10	6	5	15	6	8	20	200

Unless noted all data is 3 sigma for 60 seconds
Extending measurements to 300 seconds would be half of these values
*Cadmium data reflects longer measurement time over 240 seconds.

$$L.L.D. = 3 \times k \times \sqrt{\frac{I_{back}}{T}}$$

Test #5: Quantification: SRM 8115A   94 ppm in homogenous sample

Repeatability

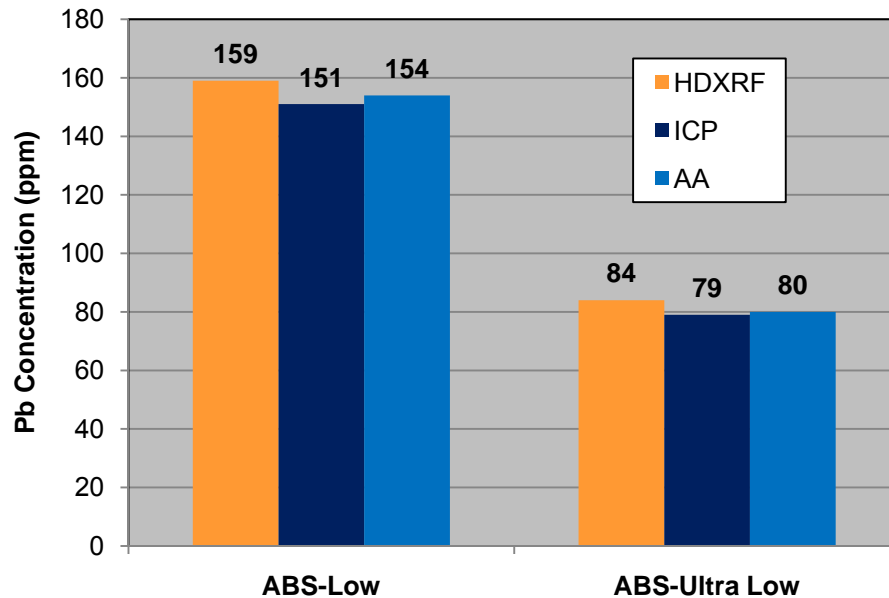30 µm paint on ABS plastic

ABS-L-T 160 ppm nominal	ABS-UL-T 80 ppm nominal	NMIJ8115 94 ppm
166	94	97
150	90	96
157	89	95
157	84	97
143	99	98
166	87	96
183	77	95
162	80	98
155	86	98
169	74	97
149	78	95
166	88	97
141	73	94
157	87	96
154	80	98
160	78	96
164	78	95
149	93	96
162	80	96
168	93	98

	ABS-L-T	ABS-UL-T	NMIJ8115
min	141	73	94
average	159	84	96.4
mode	166	78	96
median	159	85	96
max	183	99	98
StDev	10	7	1.23
StDev %	6%	9%	1%

HD**XRF**

Accuracy
Paint Layers and Substrates

30 μm paint on
ABS plastic
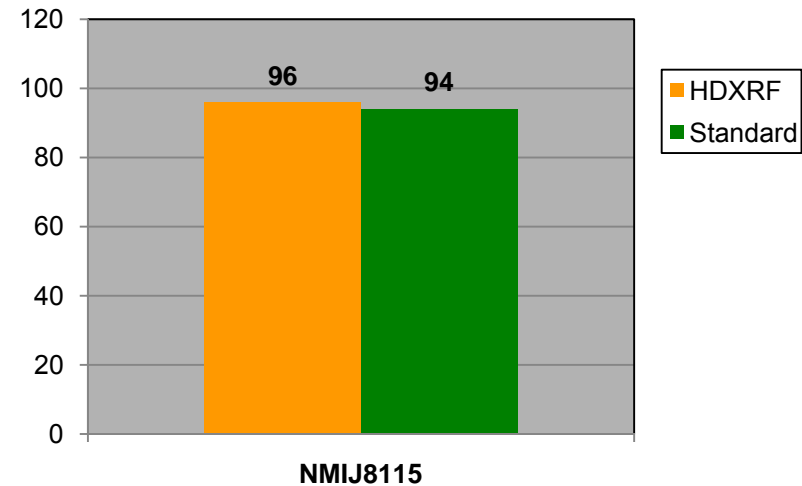
Comparative Data

Lead Levels in 30 micron Paint on ABS Plastic Substrate				
HD XRF	60	143	790	1301
FAAS	66	126	750	1296
ICP-OES	79	151	847	1400

- All data in ppm
- Samples prepared by XOS
- FAA conducted by Wadsworth Laboratories
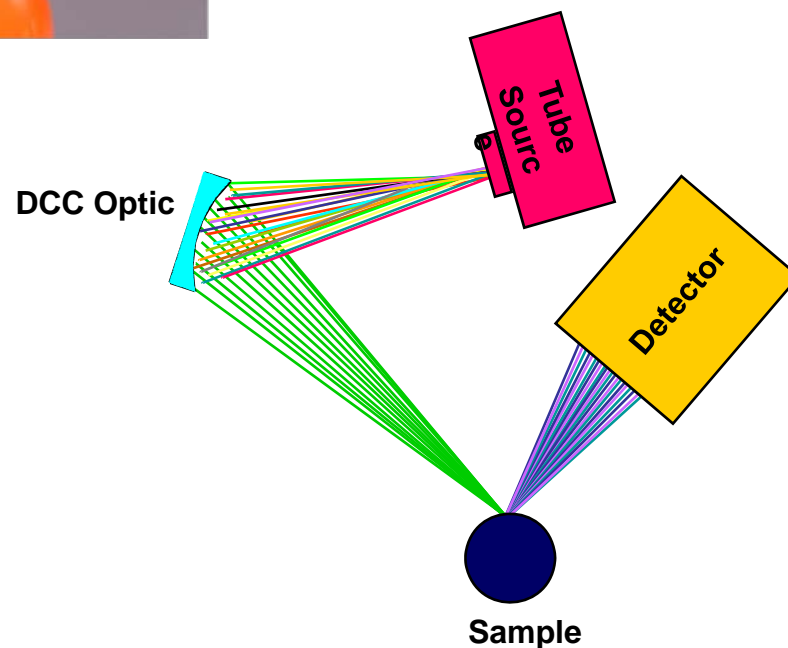- ICP-OES conducted by Galbraith Laboratories

HD**XRF**

Irregular Shapes

HD XRF

Conventional XRF

Tube

Detector

Sample

DCC Optic

Tube Source

Detector

Sample
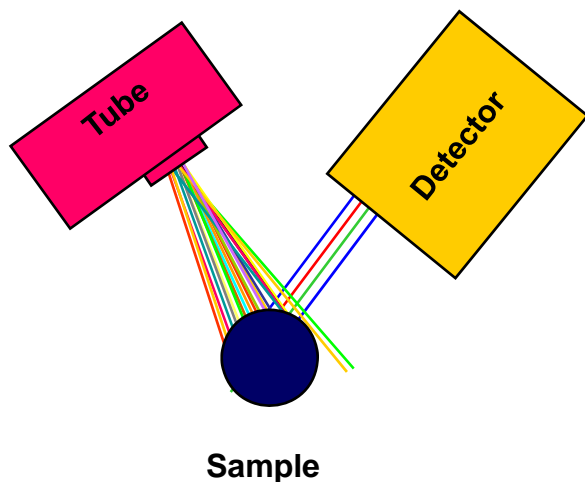
Test #6: Screening: 160 ppm in 30 um paint on curved or irregular surface

HD XRF

Substrate Matrices

- Plastics
- Wood
- Metal
- Leather
- Fabric
- Paper / Cardboard
- Glass and Ceramics

Summary of Benefits & Features

- Quantification of both Paint Layers & Substrates
  - LOD for Pb:
    - Paint 8 ppm
    - Homogeneous sample 1 ppm (PE substrate)

- Screening at 90 ppm in paint and substrate

- 10 Elements (incl. ASTM 963, + Br and Cl)

- Small Analysis Area: 1 mm

- Accurate and repeatable results with irregular shapes

- Variety of Substrate Materials

HDX 1000 Analyzer